KATHOLIEKE UNIVERSITEIT LEUVEN

Division of Mechatronics, Biostatistics and Sensors (MeBioS)
Department of Biosystems (BIOSYST)

Willem De Croylaan 42
3001 Heverlee, Belgium
phone: +32.(0)16.32.06.93
fax: +32.(0)16.32.19.96
E-mails: germanandres.vasqueznino@biw.kuleuven.be
annemie.geeraerd@biw.kuleuven.be
www.mebios.be

Microbiological risk assessment for safe food design & management

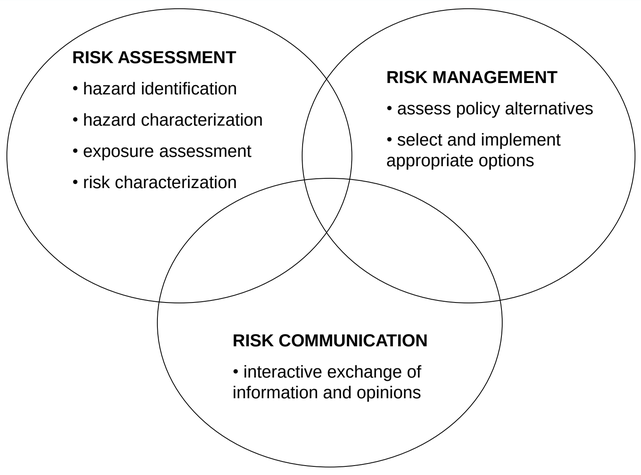
Andrés Vásquez, Pieter Busschaert and Annemie Geeraerd

LFoRCe Leuven Food Science and Nutrition Research Centre

INTRODUCTION

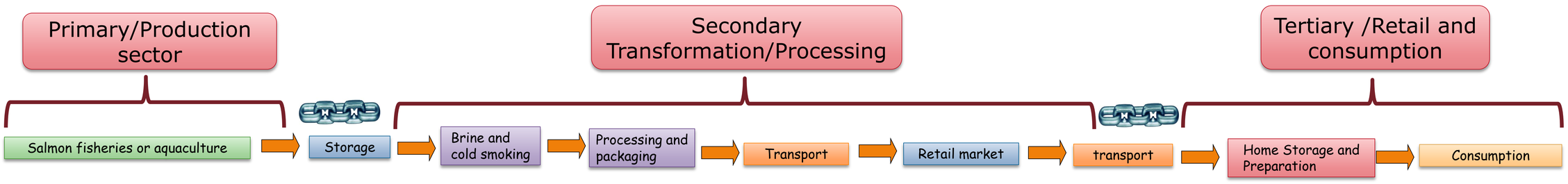
An important element of microbiological risk analysis, is risk assessment; a process in which the dynamics of microbiological hazards in the food chain are identified and characterized, and the exposure of consumers to the particular hazards is estimated.

The current focus of microbiological risk assessment studies is "*how it can best be utilized in food safety management to understand the magnitude of prevailing risk regarding a pathogen/product combination, to design risk intervention scenarios, when appropriate, and to help identify and select risk management options for implementation*". In this poster, an overview of current risk assessment techniques is illustrated using a smoked salmon chain and do's and don'ts are highlighted.

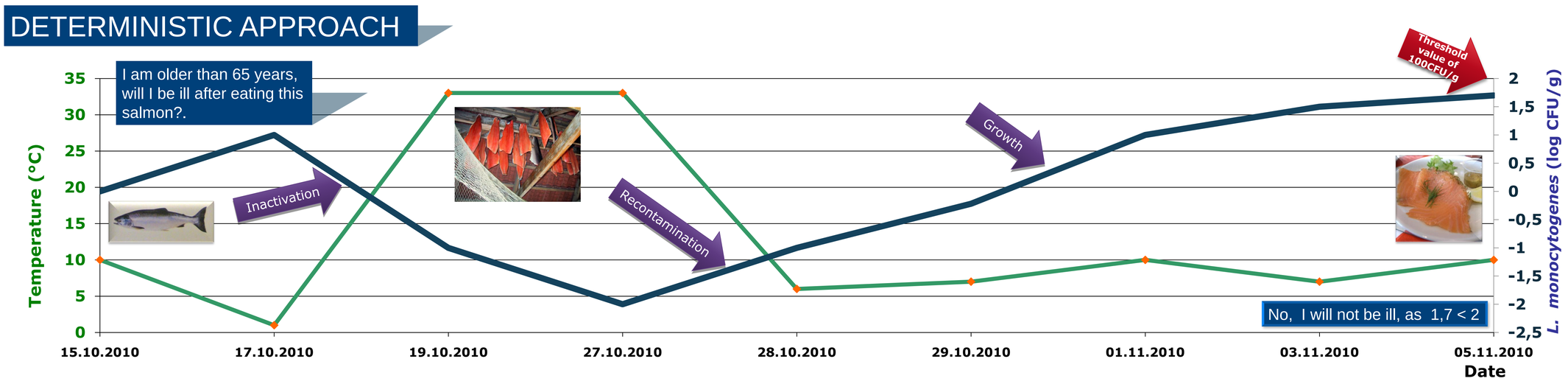


Deterministic or stochastic

Models which are used in QMRA are generally derived in a deterministic manner. However to be reliable a range of possible values should be considered. To incorporate this variation, pseudorandom values from the distributions of input variables are generally fed to the same deterministic growth (or inactivation) function by means of a Monte Carlo simulation. This approach permits to use stochastic methods rather than deterministic.



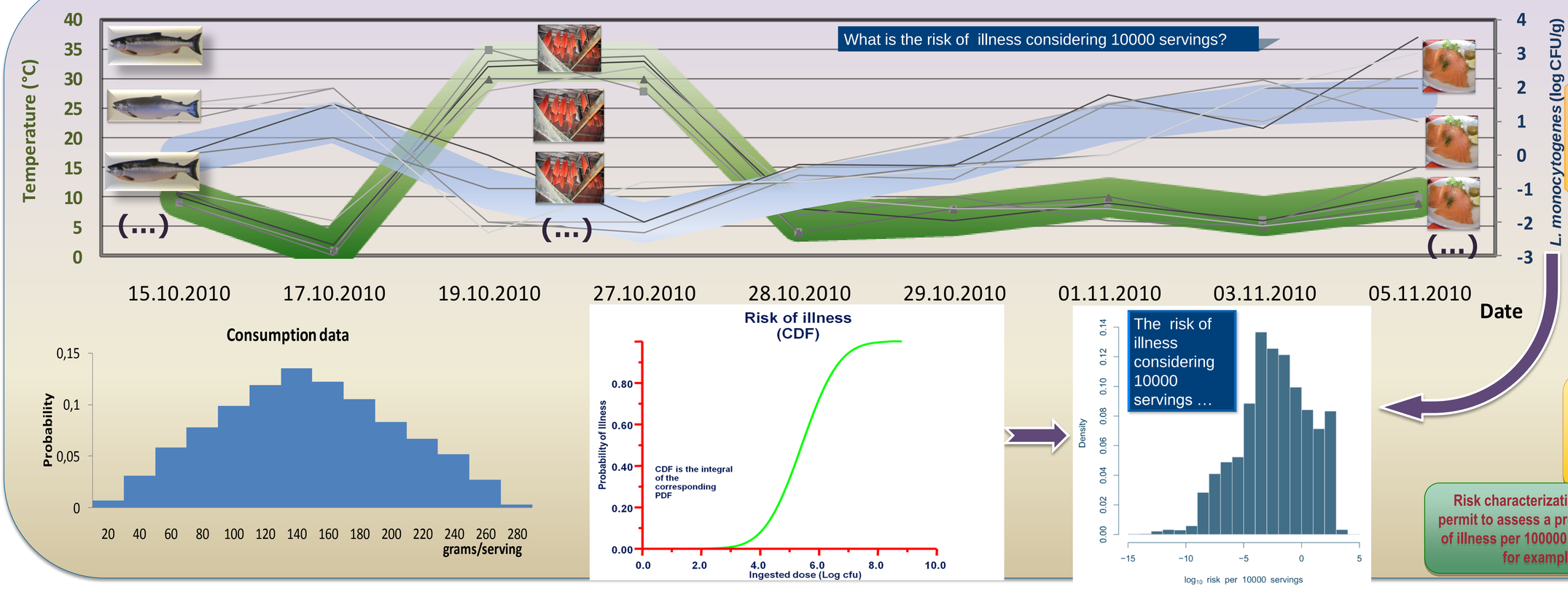
DETERMINISTIC APPROACH



With this approach just one punctual scenario could be analyzed along the chain

Risk assessment Goal: <2 log CFU/g (Commission Regulation (EC) No 2073/2005)

PROBABILISTIC/STOCHASTIC APPROACH USING MONTE CARLO SIMULATIONS



Many possible scenarios could be performed with several parameter combinations using the stochastic approach, here to distributions for every given parameter insted of punctual values are employed.

In the exposure assessment the possibility to model and assess different scenarios for contamination and intake are performed

Risk characterization would permit to assess a predicted rate of illness per 100000 population for example

SENSITIVITY ANALYSIS

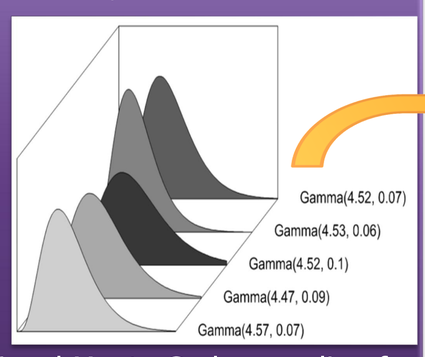
… is a tool to identify key inputs to which the output is the most correlated.
What do we have to change or what additional knowledge is needed to reduce the risk of illness?

Variability distribution: inherent, real-life variation.

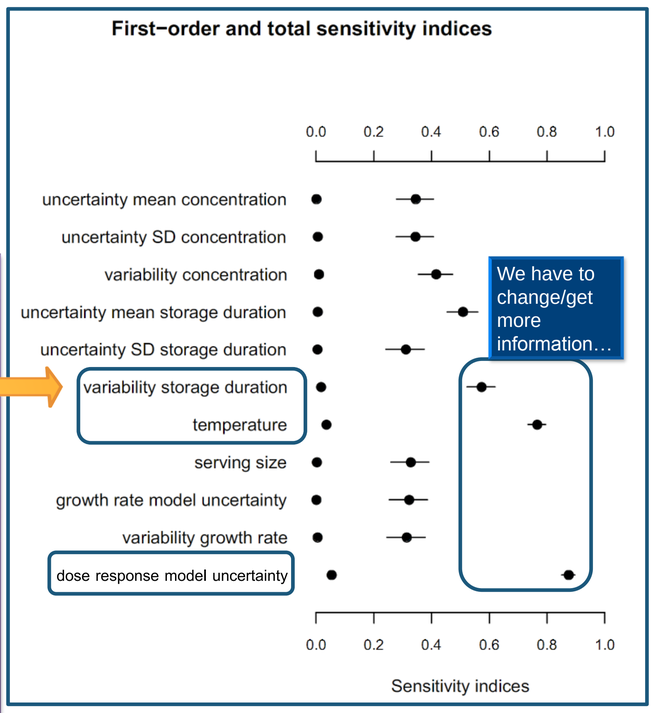
$X_j \sim$ Gamma (α_i, β_i)

α_i ~ shape $\sim \mathcal{N}(4.5, 0.01)$

β_i ~ rate $\sim \mathcal{N}(0.07, 0.01)$



Example of two-dimensional Monte Carlo sampling for an input variable of which the variability distribution is assumed to be a Gamma distribution, while the uncertainty distributions are assumed to be normal distributions.



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-"From microbiological food safety risk assessment to risk management: the case studies of *L. monocytogenes* and *Campylobacter*" (FWO-project G.0424.09N)
-MICRORISK: Microbiologische risicobeoordeling als tool om veiligheid van minimaal hittebehandelde levensmiddelen versus toepassing van traditionele pasteurizatiebarema's in te schatten (FPS Health, Food chain safety and Environment)

DO'S AND DON'TS IN RISK ASSESSMENT

- **Risk assessment must be based on sound science and sound data, should not be influenced by policy arguments.**
- **More information on dose response (pathogens ingested /probability of disease) relationship is needed.**
- **Clearly state purpose and form of the output. Which microbiological risk? In what food(s)? Under which food process and for which chain process step? For which consumers? E.g.: predicted rate of illness per 10000 servings**
- **Checking and updating the state of the art of the considered pathogen and the foodstuff.**
- **Gathering or creating databases from available data: case studies, epidemiologic and food survey data, microbiological data, food consumption and production statistics, systematic reviews of primary research**
- **Analysing the data: often available data is limited and collection of additional data is not straightforward. As a consequence, assumptions will often have to be made and/or input values will have to be decided upon by expert opinion.**
- **Meta-analysis tools could be used to improve and evaluate the quality of data assumptions in quantitative microbial risk assessment.**
- **Conclusions of risk assessment should be used for intervention measures in risk management and not conversely, and should be carefully communicated.**

References
- Principles and guidelines for the conduct of microbiological risk assessment, CAC/GL-30 (1999), FAO/WHO.
- F Pérez-Rodríguez et al., "Extracting additional risk managers information from a risk assessment of Listeria monocytogenes in deli meats.," *Journal Of Food Protection* 70, nº. 5 (May 2007): 1137-1152.
- P. Busschaert, A. H. Geeraerd, M. Uyttendaele, and J. F. Van Impe. (2010) Estimating distributions out of qualitative and (semi)quantitative microbiological contamination data for use in risk assessment. *International Journal of Food Microbiology, 138(3):260–269.*
- Jean-Christophe Augustin, "Evaluation of the sensitivity of microbiological criteria for Listeria monocytogenes in detecting unsafe food according to the prevalence of the pathogen and the shelf-life of the food," *Food Microbiology* 20, nº. 6 (December 2003): 681-689.
- M. H. Zwietering y S. J. C. van Gerwen, "Sensitivity analysis in quantitative microbial risk assessment," *International Journal of Food Microbiology* 58, nº. 3 (July 15, 2000): 213-221.
- R. Pouillot and Meryl B. Lubran, (2010)"Predictive microbiology models vs. modeling microbial growth within Listeria monocytogenes risk assessment: What parameters matter and why," *Food Microbiology* In Press, Corrected Proof (n.d.), http://www.sciencedirect.com/science/article/B6WFP-5093N3Y-2/2/651f28e3c0ed1d4b8320074eff5f2583.
- P. Busschaert, A. H. Geeraerd, M. Uyttendaele, and J. F. Van Impe. Sensitivity analysis of a two-dimensional quantitative microbiological risk assessment: keeping variability and uncertainty separated. Submitted to Risk Analysis, 2010. (Under revision)